

TECHNICAL APPLICATION GUIDE

# BreakMaster™ LIS and BreakMaster™ V

5 and 15 kV ANSI, metal-enclosed  
load interrupter switchgear





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# BreakMaster™ LIS and BreakMaster™ V

## General overview

BreakMaster LIS and BreakMaster V are IEEE/ANSI load interrupter switchgear providing dependable, economical load switching and protection for medium voltage applications from 2.4 kV through 15 kV in 600 to 1200 ampere load ratings.

### Certifications

The BreakMaster LIS and BreakMaster V line of metal-enclosed load interrupter switchgear is available with UL or cUL label. The manufacturing location for BreakMaster LIS and BreakMaster V is ISO 9001 certified.

The cUL mark indicates the product has been tested to meet Canadian Standards by the UL organization, in this case CSA C22.2 No. 31 and 193. cUL is comparable and valid as CSA certification.

### Applicable standards

BreakMaster LIS and BreakMaster V are designed, built and tested per the IEEE C37.20.3 metal-enclosed switchgear standard and meet or exceed all applicable ANSI and IEEE standards.

The National Electric Code (NEC) covers installation of electric conductors and equipment for installations identified in the NEC Article 90.

The NEC is not intended as a design specification and acceptance of an installed load interrupter switch by a local code authority relies on factors independent of the equipment as shipped from the factory. In general, equipment that bears the UL listing mark can be installed to meet the NEC.

### Construction

BreakMaster LIS and BreakMaster V load interrupter switchgear consist of a rigid, bolted frame construction enclosure. This enclosure is constructed of 11-gauge sheet steel, including the doors, back panels and side panels. All non-galvanized steel parts are treated and painted ANSI 61 gray.

All steel doors have concealed hinges and captive screws or quarter-turn latches as standard. A foot-operated doorstop is also included. Each switch compartment and the fuse or circuit breaker

compartment are provided with individual or “split” doors.

The standard depth on the indoor enclosure is 60 inches. This allows us to address special applications that require the mounting of additional devices. An optional 50-inch enclosure is available for applications requiring a reduced footprint. Each standard switch section is 35 inches wide. The split rear and side covers provide easy access. In addition, the top access covers are removable for easy access.

### Outdoor enclosures

BreakMaster LIS and BreakMaster V can be supplied in outdoor non-walk-in (ODNWI) or power distribution center (PDC) enclosures for outdoor applications.

### Interlocks

BreakMaster LIS and BreakMaster V include a mechanical switch and door interlock as standard features. These prevent the opening of the doors when the switch is in the “ON” position. They also prevent the switch from closing when the door is open.

Additionally, each switch comes with provisions for up to six optional key interlocks. These interlocks provide a mechanical method to interlock two or more devices, using a removable key which can only be inserted in one location at a time.

Table 1: Switchgear ratings (per applicable standards)

Max. kV	Impulse withstand kV (BIL)	Continuous current (A)	Momentary switch close asym. (A)	Fault close asym. (A)
4.76	60	600	40,000	40,000
4.76	60	1200	61,000	61,000
15.0	95	600	40,000	40,000
15.0	95	1200	61,000	61,000

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01  
BreakMaster LIS and  
BreakMaster V showing  
switch assembly  
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02  
BreakMaster LIS  
showing fuse assembly  
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03  
BreakMaster V showing  
circuit breaker

**Table 2: Circuit breaker ratings**

	VD4	VD4	VM1
Rated voltage, kV	15	15	15
Frequency, Hz	60	60	60
Rated nominal current, A	2000	1200	2000
Rated power frequency withstand voltage (1 min.), kV	38	38	38
Rated lightning impulse withstand voltage (peak values), kV	95	95	95
Rated short circuit breaking current, kA	31.5	40	31.5
Rated short time withstand current (3 sec.), kA	31.5	40	31.5
Rated peak making current, A	82	104	82
Actuator	Spring	Spring	Magnetic
Interrupting time, ms	≤50	≤50	≤50
Closing time, ms	30 to 60	30 to 80	30 to 60



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02



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### Applications

BreakMaster LIS and BreakMaster V are used mainly as a primary or secondary disconnect switch for transformers, but the variety of configurations in which BreakMaster LIS and BreakMaster V are available also make them useful for specific distribution needs. They can be used in a single circuit for on/off control of a transformer, duplex switching and selector switch applications.

Typical applications are in oil and gas, pulp and paper, automotive, industrial processes, wastewater, petrochemical and utility-type industries.

### Fuses and circuit breakers

BreakMaster LIS is available with a variety of different fuses to meet specific application needs. Contact the factory for specific fuse options.

BreakMaster V is available with circuit breaker options shown in Table 4.

**Table 3: Fuse ratings**

Fuse	Fuse type	Voltage class	Ampere range
Current-limiting fuses		5 kV	25 A–900 A
	EJO 1	15 kV	20 A–300 A
	RBA200	5 kV–15 kV	40 E–200 E
Expulsion fuses	RBA400	5 kV–15 kV	20 E–300 E
	RBA800	5 kV–15 kV	450 E–720 E

**Table 4: Circuit breakers**

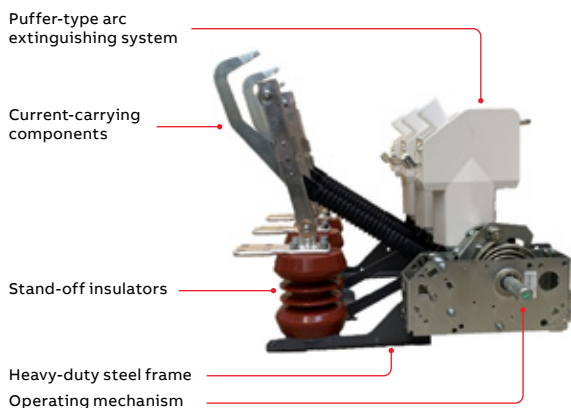
Breaker	Mech. type	Pole distance (mm)	Continuous current (A)	Rated short-circuit breaking current (A)
VD4	Spring	210	2000	31.5
VD4	Spring	210	1200	40
VM1	Magnetic	210	2000	31.5



A phase loss detection relay and PTs are installed on load side of fuses and for circuit breakers, the PTs are installed at the top side, in the switch compartments, and wired to terminal blocks to provide blown fuse indication. For blown fuse trip option, a shunt trip is installed in addition to the components above and wired to terminal blocks for external power source, provided by others. A capacitive trip device can be provided, but it is a manual selection in the sales configurator and must be quoted by the factory.

### Switch mechanism

BreakMaster LIS and BreakMaster V switchgear consist of a two-position (open, closed), three-pole, gang-operated, air interrupter switch using two different style mechanisms for both closing and opening functions. The K-mechanism is a single spring snap action device. The switch opens or closes by charging the spring past dead center using a manual operating handle. The A-mechanism is a dual spring stored energy device that is well suited for remote tripping applications. When shunt tripping, mechanical fuse or circuit breaker tripping is specified, the type A-mechanism must be used. In closed operation, the opening spring is charged and latched by an operating handle or by a motor operator.



### Standard features

- Silver-plated copper bus
- Full-length ground bus
- Polyester coat paint
- ANSI 61 paint color (gray)
- Oversized viewing window
- Full height interphase barriers
- 11-gauge doors, barriers and covers
- Generous cable termination area
- Permanent non-corrosive nameplate
- Individual doors over switch and fuses
- Concealed door hinges
- Switch padlock provisions
- Key interlock provisions
- Split rear and side covers
- Tungsten-tipped arc interrupting blade
- Mechanical switch and door interlocking
- Louvered ventilation at top and bottom
- Safety horizontal barrier
- Standard outdoor features
- Removable filters for louvers
- Long-life space heaters
- 4-inch channel base
- Sloped roof
- Bottom closure plates
- Rodent barriers

### Testing

BreakMaster LIS and BreakMaster V are design tested per IEEE C37.20.3 and subjected to the following production tests:

- High potential insulation test on control wiring and power cabling
- Control circuit verification
- Functional operation tests on all devices
- Mechanical check for kirk locks and switch and door interlocks
- Relays checked for proper performance characteristics
- Ratio and interconnection check for potential transformers
- Polarity verification for current transformers

Factory witness testing is also available on request.

Table 5: VersaRupter® switch configurations

Operating mechanism		Handle operator (right side)		Aux. switch	Shunt trip		NM motor (left side)
K-mech.	A-mech.	Chain drive	HM direct drive	6-contact	125 V DC	110 V AC	110 V AC/DC
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**Optional accessories and features**

- UL/cUL listing
- Seismic certification
- Copper tin-plated bus
- Insulated bus and bus boots over joints
- 80 kA momentary bus rating
- Weather and dust resistant
- NEMA 2 drip-proof enclosure
- Rear doors (full height or double)
- Vertical barriers
- Rodent barriers
- Bottom closure plates
- Tamper-resistant hardware
- Auxiliary switches (3 NO-3 NC)
- Thermostat
- Space heater (standard on outdoor, optional on indoor)
- Porcelain insulators
- Customer metering
- Surge arresters
- Mimic bus
- Space heater switch
- Ground studs
- Convenience light
- Duplex receptacle
- Top hat
- Run back bus

Table 6: Other reference documents

Document	Document number
BreakMaster™ LIS Descriptive Bulletin	1VAL107101-DB
BreakMaster™ V Descriptive Bulletin	1VAL107102-DB
BreakMaster LIS Flyer	1VAL107101-FL
BreakMaster V Flyer	1VAL107102-FL
BreakMaster LIS and BreakMaster V Technical Guide	1VAL107101-TG
BreakMaster V Installation, Operation and Maintenance Manual	1VAL107102-MB
BreakMaster LIS Installation, Operation and Maintenance Manual	1VAL107101-MB
VersaRupter® MV Indoor Switch Descriptive Bulletin	1VAL206001-DB
VersaRupter Installation, Operation and Maintenance Manual	IB2.1.2.7-4A
Switchgear Components and Accessories Technical Guide	1VAL104601-TG
REF615 Feeder Protection Relay Product Guide	1MAC105361-PG
RET615 Transformer Protection Relay Product Guide	1MAC204375-PG
REA Arc Fault Protection System Product Guide	1MRS756449
Application Guide for SwitchgearMD™ used in MV Metal-Clad Switchgear, MCC, Load Interrupter Switch and Limitamp®	2RGA030591

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Full height interphase  
barriers

### Product design and features

BreakMaster LIS and BreakMaster V load interrupter switchgear integrate the superior technology available in ABB devices such as the VersaRupter switch, featuring advanced interrupting technology. The mechanical design of the BreakMaster LIS and BreakMaster V is optimized for flexibility, personnel and equipment protection and ease of maintenance and installation. BreakMaster features, such as full height interphase barriers for BreakMaster LIS with fuses and interphase barriers at superior switch compartment for BreakMaster V, split-door design, horizontal barriers between the switch mechanism and fuse compartment, oversized viewing window and a separate enclosed, low voltage panel, are designed for a higher level of reliability, safety and convenience.



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### Enclosure features

These steel-enclosed switch sections can be joined together to centralize, protect and switch loads of the most complex systems for medium voltage circuit applications, or the simplest of loads such as primary or secondary disconnect switch for transformers. As the need arises, additional sections can be added to an existing line-up in the field, often times without the need for a transition section. A paint finish is applied to all unplated steel parts. The powder-coating paint process passes 1000 hours per ASTM 117B salt spray tests for all exterior parts and provides lasting protection.

### Unit features

An array of optional multi-function meters measure volts, amps, frequency, power factor, watts and VARs, and can communicate via IEC 61850 RS-232, RS-485 and Modbus. For safety, an enclosed, low voltage panel completely isolates metering components.

While accessing fuses or circuit breaker, the split door prevents access to the live side of the switch when the lower door is open. Oversized viewing window and switch position markers allow visual verification of switch position.

Full height interphase barriers are standard on all switches for BreakMaster LIS with fuses and interphase barriers for switch compartment on BreakMaster V. Both current-limiting and expulsion fuses are available. A 60-inch depth standard section is available when customer preference and/or specific options require additional space. An optional 50-inch section depth still provides substantial space for incoming or outgoing cables. Horizontal barriers between the switch mechanism and lower (fuse or circuit breaker) compartment are a standard safety feature.

Convenient split rear covers provide easy access to cable terminations or devices located in the rear of the section.

### Nameplates

Unit service designation nameplates are furnished when specified. These nameplates can be supplied as blanks suitable for field engraving, or engraved at the factory. The standard unit service designation nameplate is of 2-ply thermoplastic material, black face with white core, 2-5/32 inches x 3-1/2 inches, or 1 inches x 3 inches, depending on the unit configuration, fastened with non-corrosive nylon clips. Stainless steel screws are available as an option. Nameplates are engraved with white letters on a black background unless specified otherwise.

### Wire and cable

Standard control wire size is 14 AWG. Standard control and power wire include flame-retardant (VW-1), moisture-, heat- and oil-resistant thermoplastic insulation rated 600 V, with stranded copper conductors, type MTW. Wire is rated 90 °C and terminals are rated 75 °C. Connections to space heater terminals use 14 AWG, 600 V, 250 °C Teflon wire.



Per NEC 79 - 13.2.4.3, the standard colors<sup>1</sup> are:  
AC (120/208/240 volts)

- Black — phase 1
- Red — phase 2
- Blue — phase 3
- White — neutral
- Green — ground

AC (277/480 volts)

- Brown — phase 1
- Orange — phase 2
- Yellow — phase 3
- Gray — neutral
- Green — ground

Optional wiring available includes SIS heat-resistant synthetic rubber-covered switchboard wire and XHHW flame-retardant cross-linked synthetic polymer, both rated 600 V with stranded copper conductors, and a VW-1 flame rating (no PVC). Wire is rated 90 °C and terminals are rated 75 °C.

#### NOTICE

**Notice:** Not all colors are available with optional wiring.

#### Environmental conditions

BreakMaster LIS and BreakMaster V are designed for operation in a clean, indoor environment having a 40 °C maximum ambient temperature. The nominal minimum temperature for storage is -40 °C and for operation, -20 °C. Space heaters are recommended whenever temperature conditions below 0 °C will exist. Where extreme cold temperatures will be encountered for long periods of time, it is recommended that the load interrupter switch be installed in a heated room or enclosure. Average value of relative humidity, measured over a 24-hour period, should not exceed 95% non-condensing.

For outdoor installations, NEMA 3R non-walk-in weatherproof enclosures are required. Thermostatically controlled space heaters should be considered for these applications.

The altitude limit for the standard load interrupter switchgear design is 6600 feet. Applications above this altitude should be referred to the factory for derating recommendations. Some components have a lower altitude rating and may reduce the altitude limit of the load interrupter switchgear.

Fungus-proofing of organic materials is inherent. Keeping equipment dry and above the dew point is the best way of avoiding fungus growth, and the use of space heaters is recommended for this purpose. Heaters should be energized if the load interrupter switch is to be stored for any length of time. Where export crating is involved, provisions must be made on the outside of the crate for access to space heaters.

#### Seismic certification

BreakMaster load interrupter switchgear is seismically qualified through shake table testing. Several samples, representative of the most seismically vulnerable product configurations, were tested to certify the entire product line. Equipment remained structurally sound, and devices functioned properly during and after the seismic event. Certification of BreakMaster load interrupter switchgear with ABB VersaRupter switches / ABB VD4 breaker is based on the prior successful shake table test results of the BreakMaster load interrupter switchgear in accordance with section 17.05.14.3 of CBC 2022 / IBC 2021 and the 2015-ICC-ES AC156 standards. The seismic certification of the ABB VersaRupter switches / ABB VD4 breakers is through the experienced-based data methodology specified in section 13.2.7 of ASCE 7-22.

BreakMaster load interrupter switchgear is certified to the following IBC-2021 / CBC-2022 levels:  $I_p = 1.5$   $S_{ds} = 2.0$  g at all  $z/h$  levels. BreakMaster load interrupter switchgear is certified to the following IEEE-693-2018 levels: High with 2.5 amplification factor. IBC-2021 / CBC-2022 requirements are specified using three key variables:

- $S_{ds}$  — A measure of equipment base acceleration.  $S_{ds}$  values range from 0 to 2.0 and are multiples of g-force.
- $I_p$  — An importance factor.  $I_p$  levels range from 1.0 to 1.5. All ABB equipment with IBC-2021 / CBC-2022 certification is qualified to an  $I_p$  level of 1.5, indicating the equipment will be fully functional during and after a seismic event.
- $z/h$  — A measure of the equipment mounting location inside or outside a building.  $Z/h$  ranges from 0 to 1, where  $h$  is the total building height and  $z$  is the vertical distance between ground level and the equipment installation location. Ground and roof mounted equipment, for example, would have  $z/h$  levels of 0 and 1, respectively.

# Structure

## Enclosure types

Load interrupter switchgear is made up of standardized vertical sections housing vertical and horizontal bus, wiring channels and compartmented control units. Sections may be bolted together to form a single panel assembly powered by line connection at a single point. Normal shipping split is three sections maximum.

## NEMA type 1 – gasketed – semi dust-tight, indoor

Intended to cushion doors and mitigate vibration. Standard finish is light-gray ANSI 61 over a phosphate rust inhibitor. All unpainted parts are zinc-plated or galvanized. Enclosures are furnished with bolt-on rear covers. Hinged rear doors are available as an option. Pan-type doors utilize quarter-turn fasteners. Gasketed doors, cover plates and operating handles are available as an option. Two heavy-duty 3 inch by 1-1/2 inch, 12-gauge floor sills and 1/4 inch structural lifting lugs are included. Open bottom is standard.

## NEMA type 2 – Drip-proof, indoor

Intended for use indoors to protect the enclosed equipment against falling non-corrosive liquids and falling dirt. Dripshields on top of the load interrupter switches and neoprene closed-cell gasketing afford protection from falling and splashing liquids.

They are not water-tight. Similar to NEMA 12 gasketed construction except with catch pan-type dripshield on top and with open bottom.

Dripshield extends four inches beyond front of load interrupter switch. Standard finish: light gray ANSI 61. Furnished with removable conduit cover plates unless otherwise specified.

## Ground switch

Grounding switches are available for grounding the hinged side of the VersaRupter switch in a two-step operation. When the VersaRupter switch is open, a mechanical interlock enables the ground switch to be closed using a separate manual operator. The mechanical interlock prevents the VersaRupter switch from being closed while the grounding switch is closed. Grounding switches mount to the base of the structure.

The grounding switch is spring-loaded and provides a direct path to ground when the switch and/or fuse is opened. The grounding switch springs rotate three blade contacts, which engage the pivot side primary connections. This device is typically used to direct residual energy stored in the load side of the circuit to ground. The sections with a grounding switch are a minimum of 40 inches wide and are available in 50 and 60 inch depths.

## NEMA type 3R – Rain-proof, outdoor

Intended for use outdoors to protect the enclosed equipment against rain. They are not dust-proof, snow-proof nor sleet proof (ice-proof). Optional lights and receptacles available. The non-walk-in enclosure consists of a specially constructed, fully gasketed section with a mating framework, which supports the labyrinth-type sloped roof and extended front. Extended front is not standard, it is optional at an additional cost. The enclosure is designed for bottom cable entry and exit, but top entry and exit is also available. Mesh filters are included on the ventilation louvers, and the enclosure is equipped with a 90° door with wind stop and three-point door latch. Thermostatically controlled space heaters and 4-inch floor channels are provided as standard.

## AC power bus system

This bus is available in ratings of 600 A, 1200 A and 2000 A and may be tin-plated copper, silver-plated copper or bare copper. The horizontal bus is rated 95 kV basic impulse level (BIL). Mechanical strength under short-circuit currents is 25 kA RMS symmetrical for 40 kA switch or 38 kA RMS symmetrical for 61 kA switch.

## Ground bus system

The ground bus is normally located near the AC power bus on the inside rear of the enclosure. The bus provides a common termination point for all ground connections within each switch section, including the enclosing case, and offers a convenient terminal for incoming ground cables. It should be noted that the customer must make a suitable ground connection to the bus in order to make it effective. When ground bus is not provided, the ground connection may be made to the ground stud provided.

**Control bus system**

Control (wired) bus is a convenient means of conducting control power throughout a group of switches joined together in a line-up. Conductors from a single control power source may be terminated in one unit in the line-up, and the control bus employed to distribute the power to each unit of the grouped line-up. Control bus may also be used to distribute the power from a single control transformer located in the line-up.

Control bus normally consists of properly sized insulated wire conductors run between terminal boards. Standard voltage for control bus is 120 or 240 volts AC, and maximum current rating is determined by application, such as total present and anticipated future load.

**Enclosure options****Space heaters**

Space heaters are used to prevent moisture condensation on the inside of the load interrupter switchgear. One heater (62.5 watts at 120 V AC) is installed in the bottom of each vertical section. UL requires space heaters be controlled by a thermostat. One thermostat can control up to 23 heaters and is located in the top horizontal wireway.

A terminal board for connecting an external 120 V AC power source is standard.

The terminal board is located in the top horizontal wireway adjacent to the thermostat(s).

This is recommended because it permits the space heaters to be energized even when the load interrupter switchgear itself is de-energized. If export crating is involved, the space heater circuit can be wired to an external plug for energizing the heaters during shipment and storage.

When specified, space heater power can be provided from within the load interrupter switchgear.

**Bottom plates**

Plates bolt onto the bottom of each load interrupter switchgear section. They may be removed to facilitate installing conduit.

**Extended height pull box (top hat)**

A pull box can be mounted on top of a vertical section when specified. The standard height is 12 inches; 6-, 18- and 24-inch heights are also available. Top, front and end covers are removable for access.

**Rodent barriers**

Metal plates bolted to the bottom of each end section to close the opening between the front and rear floor sills. Not required if the floor sills will be removed or embedded in concrete.



# Configurations

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Incoming cable section

The complete line of BreakMaster LIS and BreakMaster V load interrupter switchgear can fill most distribution system requirements. They are available in a variety of configurations to

meet specific distribution needs, including single switches, duplex switches and line-ups. Motor operators, customer metering and outdoor construction are also available.

Table 7: Standard configurations

Standard configuration features	Single	Duplex	Line-up
35" width	•		
40" width (motor-operated switch)	•		
70" width		•	
90" indoor height, 99" outdoor height	•	•	•
60" depth standard, 50" depth optional (includes arrester if required)	•	•	•
Available section widths: 55" mains/tie; 35" branches; 20" / 35" incoming terminal compartments; 20" / 35" / 40" auxiliary sections			•
Extension required for oil-filled transformers only (18" wide)	•	•	•
Dry type and cast coil transformers require 3" in throat for outdoor enclosure	•	•	•
Key interlocking standard between switches and fuse compartment		•	

### Weights and dimensions

BreakMaster LIS and BreakMaster V load interrupter switchgear vary in weight by configuration type and construction. The approximate weight for estimating purposes is included in Table 8.

Table 8: Typical switchgear weights

Configuration	Weight (kg/lbs)	
	NEMA 1	NEMA 3R
Single	635/1400	794/1750
Mains/ties	907/2000	1179/2600
Branch	635/1400	794/1750
20" wide incoming cable	272/600	386/850
35" wide incoming cable	476/1050	635/1400

Table 9: Circuit breaker weights

Model	Description	Weight (kg/lbs)
VD4/N IS.2032 P2IO	Fixed VCB 15 kV/2000 A/ 31.5 kA P2IO	80/ 176
VD4 15.12.40 P2IO	Fixed VCB 15 kV/1200–2000 A/ 40 kA P2IO	75/ 165
VMI/N 152032 P2IO	Fixed VCB 15 kV/2000 A/ 31.5 kA P2IO	130/ 287

### Cable terminals

Terminal lugs for either line or load cables are not supplied unless specified. Mechanical compression lugs or NEMA 2-hole compression-type lugs can be supplied as options. The customer must specify the number and size cable when lugs are to be supplied by ABB.

### Incoming cable section

The incoming section provides an optional cable-entrance compartment and can be 20"W or 35"W.



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06

- 07 Single
- 08 Duplex
- 09 Line-up (main-tie-main)

### 20"W incoming

Can have top or bottom cable entry. Arresters are available to be installed only for top entry configuration. This meets front access only and front and rear access. Can be 50"D or 60"D and configured to feed to left or to right side.

### 35"W incoming

- **Can be configured as center tap (bus provisions to extend to both sides)**

This option can be set up with top or bottom cable entry. Arresters available on both options. CTs, PTs and CPTs available to be installed on it (PT and CPT can't be installed at the same time). 50"D available, 60"D required for PT or CPT installation. LV box with meter or relay can be provided. This option allows more space for lugs for cable entry due to bigger lug strap included.

- **Or to feed to one specific side (left or right)**

This option can be set up with top or bottom cable entry. Arresters available on both options. CTs, PTs and CPTs available to be installed on it (PT and CPT can be installed at the same time). 50"D available, 60"D required for PT or CPT installation. LV box with meter or relay can be provided.

### Transition section

BreakMaster LIS and BreakMaster V can be close-coupled to transformers and switchgear by a transition compartment to make a continuous line-up. The transition compartment is normally 20 inches wide; however, this can vary.

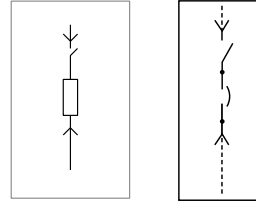
### Lineups

Features of a line-up include:

- 600, 1200 and 2000 A horizontal through bus
- Incoming line sections, main, tie (non-fused), branch switches, auxiliary (both bussed and unbussed), and transitions to other equipment are available

### Single switch

The single switch section provides ON/OFF switching using one load break switch section, fused, circuit breaker or non-fused as options, that can be configured as stand-alone (cable in/out) or with transition to incoming line side and bus bar connection for transformer for load side.



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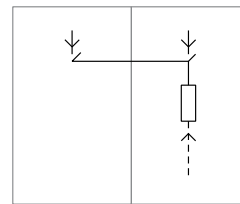
### Duplex switch (only for BreakMaster LIS)

The duplex switch provides on/off switching, using two load break switch sections (one fused, one unfused) connected to a common load. Mechanical interlocks (key interlocks) prevent both switches from being closed at the same time.

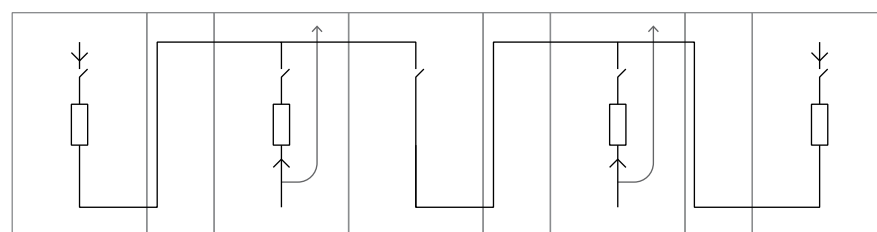
The duplex switch functions as a switch between two power sources, such as a primary and auxiliary power source.

The features of a duplex switch include:

- Two sections 35-inches wide, connected together
- One set of power fuses
- Four key interlocks included as standard



08



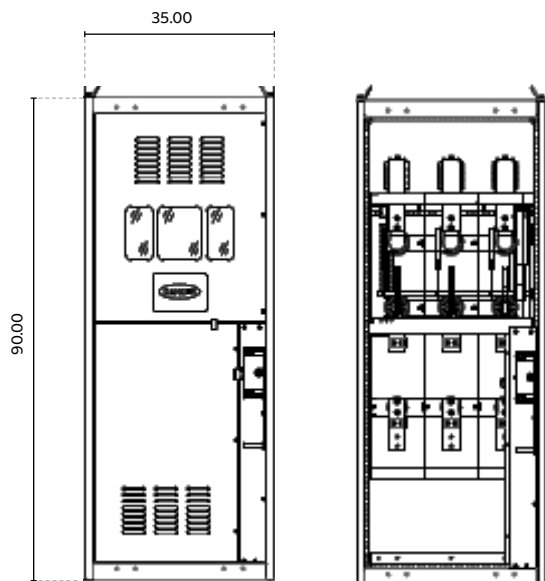
09



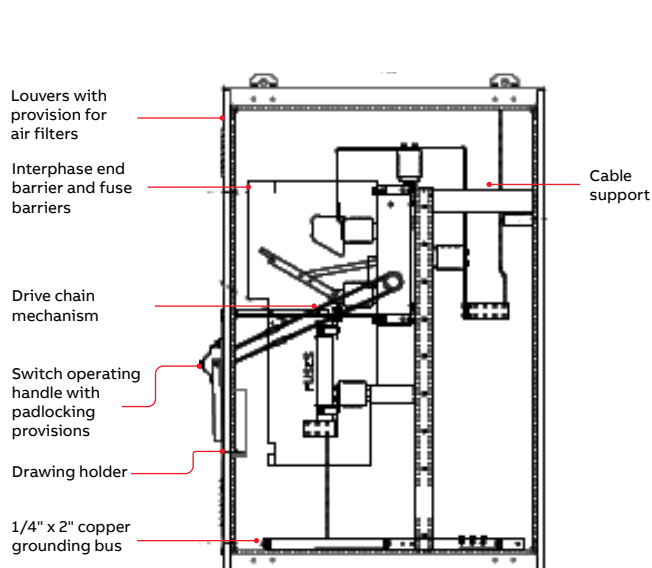
# Enclosure outline dimensions

## Single switch NEMA 1

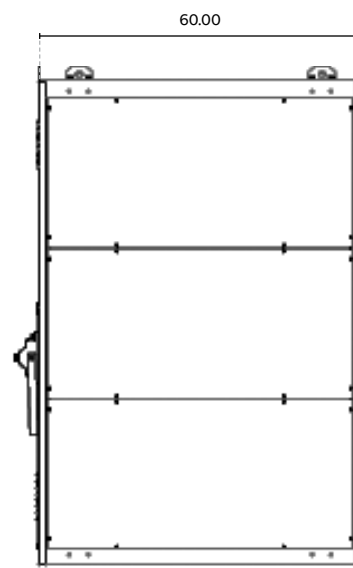
- 10  
Front view with and  
without covers  
—  
11  
Side view without covers  
—  
12  
Right side view



—  
10



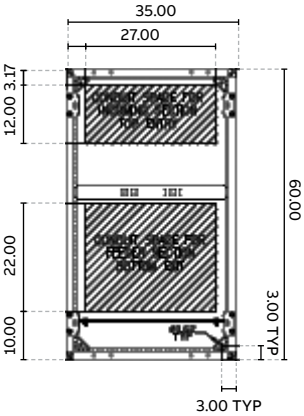
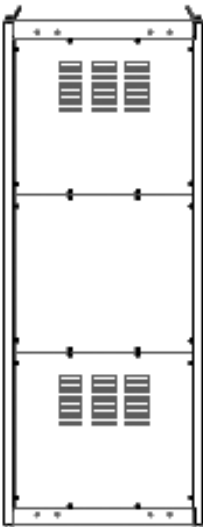
—  
11



—  
12

All dimensions are in inches.

- 13 Rear view
- 14 Enclosure front top view
- 15 Fastening floor detail: without scale
- 16 Section A-A partial front view



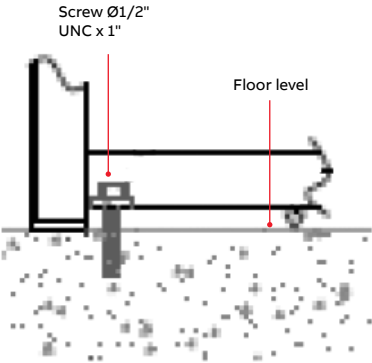
NOTICE

**Notice:** If anchor bolts are to be embedded in the foundation, they must be located according to the drawing furnished by ABB for the specific equipment. Anchor bolts should be 1/2 inch diameter, of grade 2 steel (minimum) in non-seismic locations. Bolts must extend a minimum of 2-11/32 inch above grade to 3/4 inch above the floor channel.

NOTICE

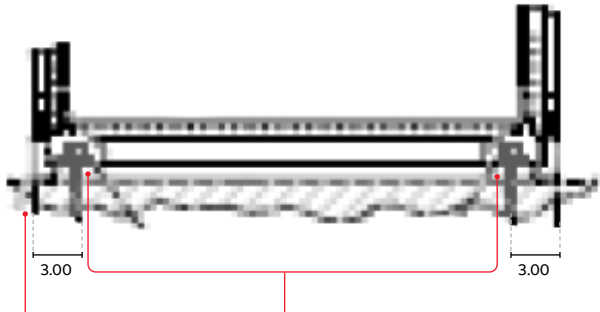
**Notice:** For seismic applications, use 1/2-inch x 13 TPI, grade 5 bolts, torqued to 50 foot-pounds, located in each of the four corners in each section.

13



Anchoring front

15



Floor line

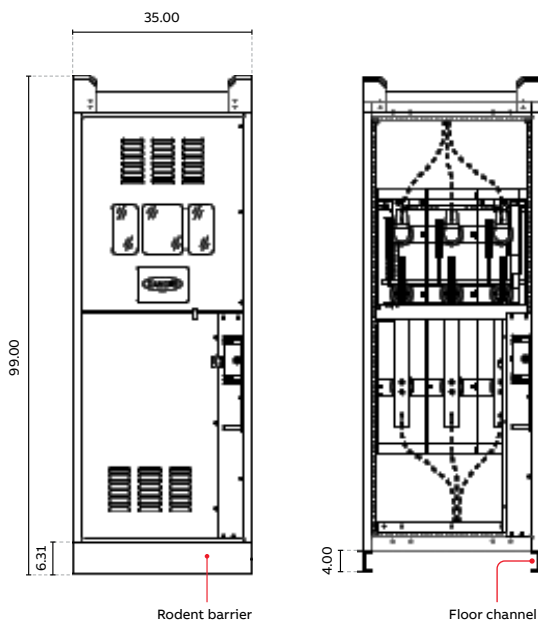
**Note:** Grouting gusset is 1" above floor line. Sufficient bolt length must be allowed.

16

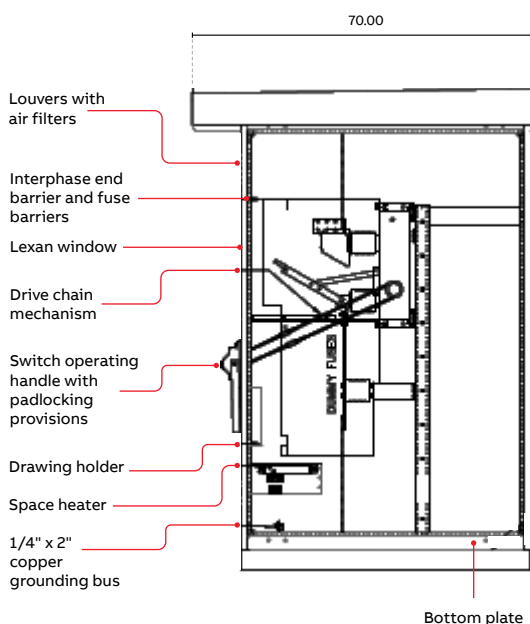
# Enclosure outline dimensions

## Single switch NEMA 3R

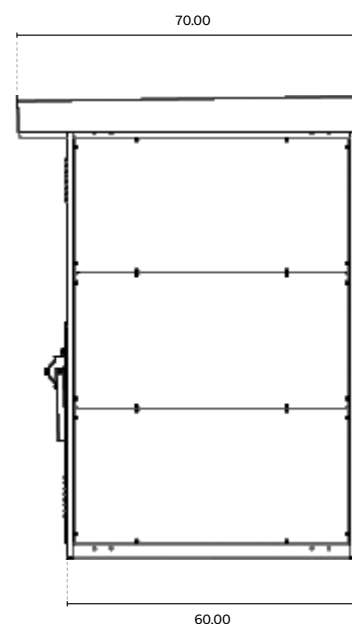
- 17 Front view with and without covers
- 18 Side view with covers
- 19 Side view



17



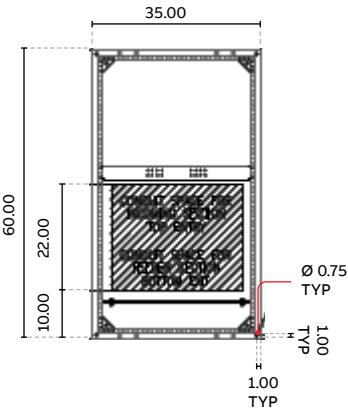
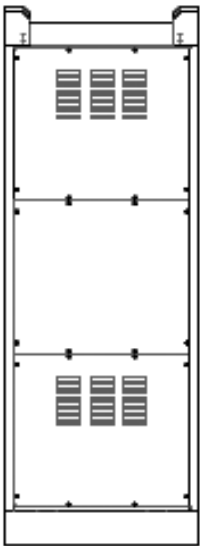
18



19

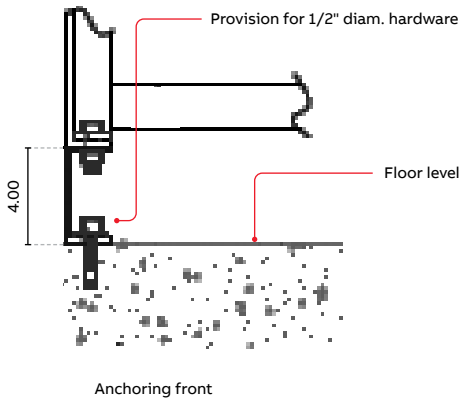
All dimensions are in inches.

- 20  
Rear view
- 21  
Enclosure front top view
- 22  
Fastening floor detail:  
without scale
- 23  
Section A-A partial  
front view

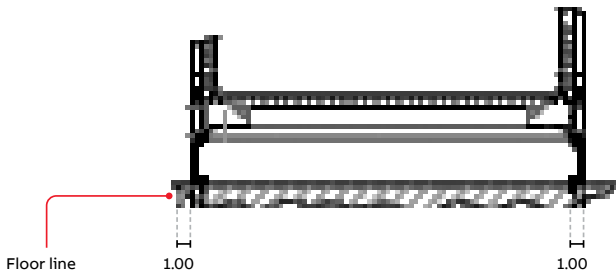


20

21



22

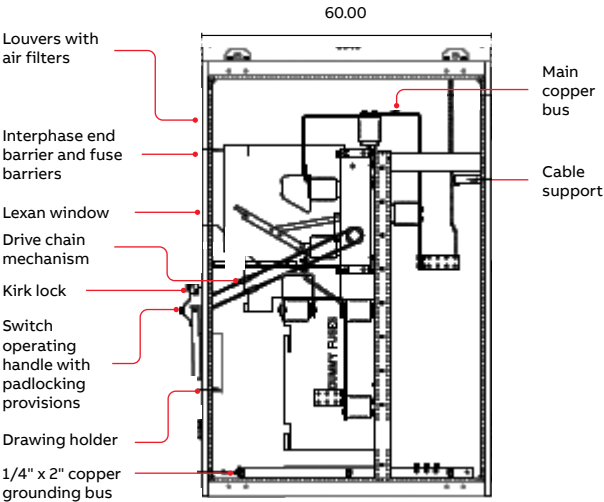
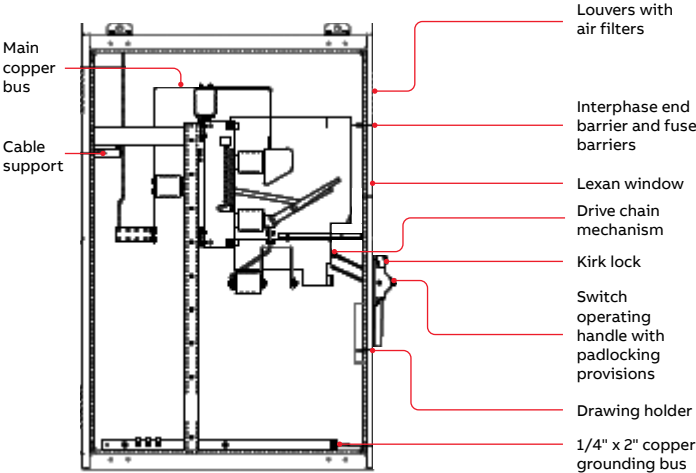
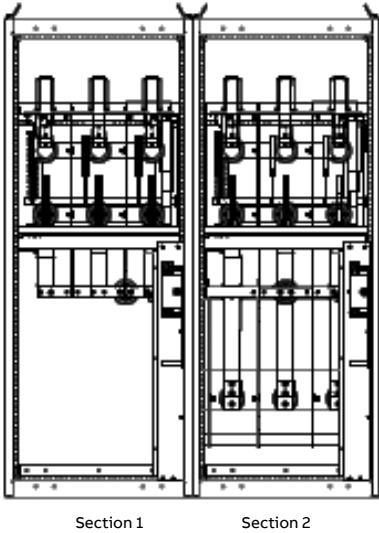
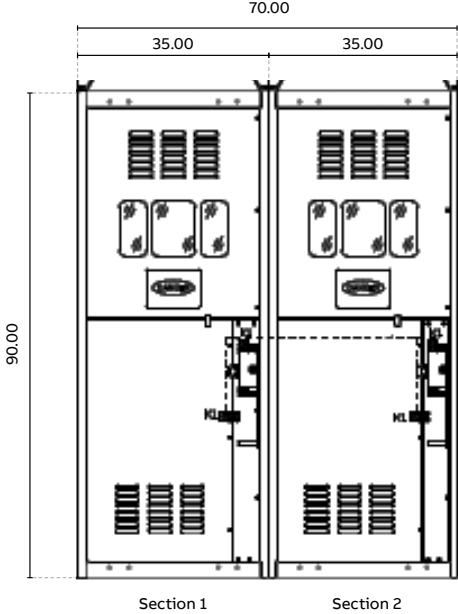


23

# Enclosure outline dimensions

## Duplex switch NEMA 1

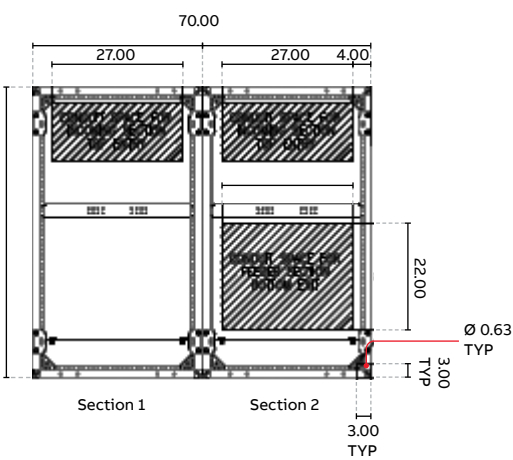
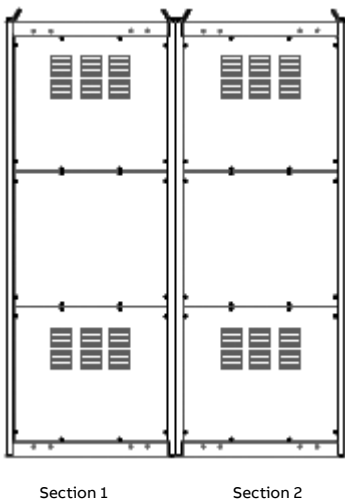
- 24 Front view
- 25 Front view without covers
- 26 Side view without covers section 1
- 27 Side view without covers section 2



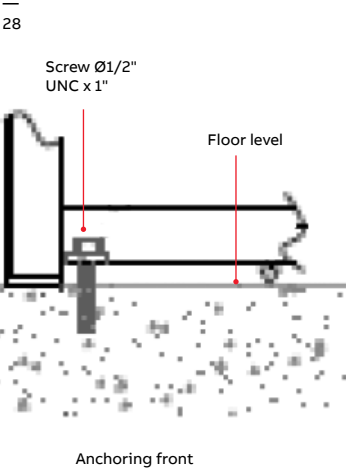
All dimensions are in inches.



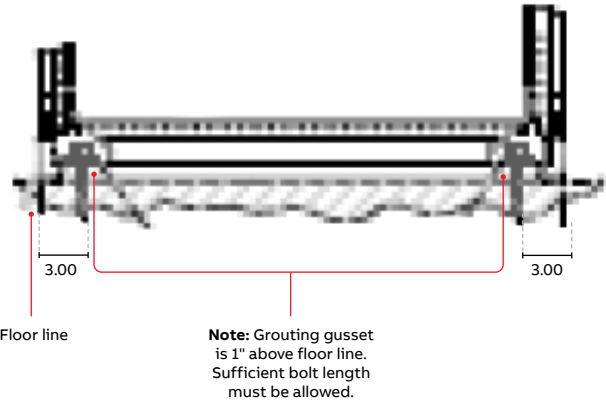
- 28 Rear view
- 29 Enclosure front top view
- 30 Fastening floor detail: without scale
- 31 Section A-A partial front view



29



30

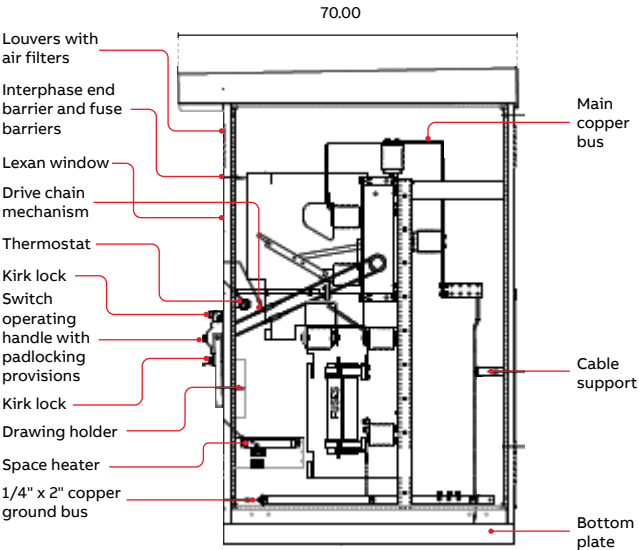
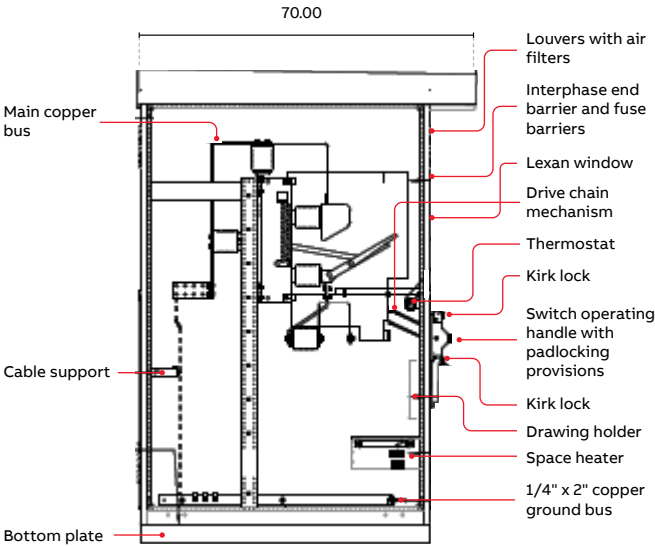
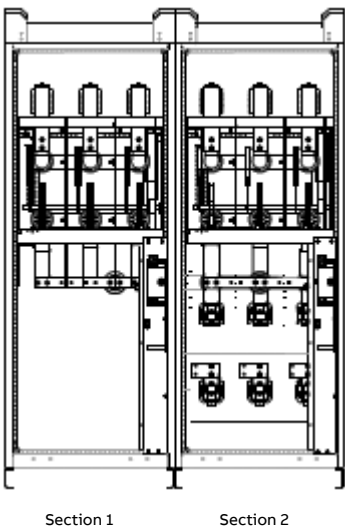
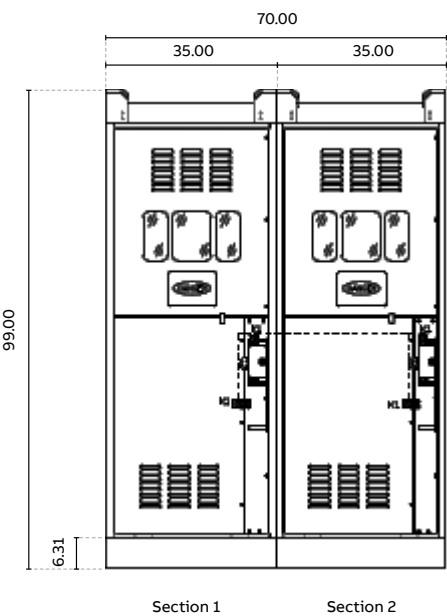


31

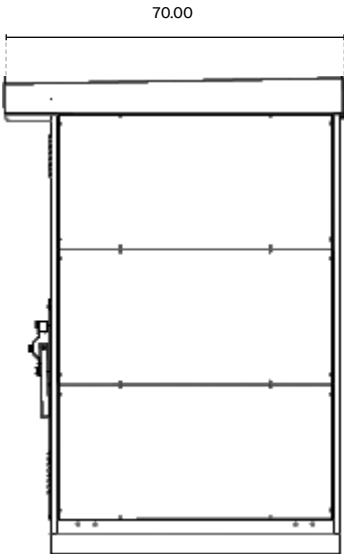
# Enclosure outline dimensions

## Duplex switch NEMA 3R

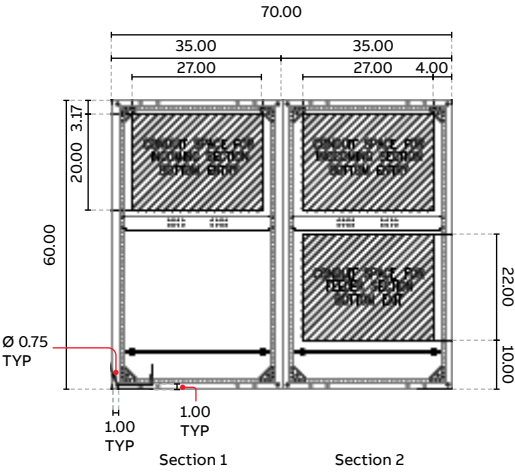
- 32 Front view
- 33 Front view without covers
- 34 Side view without covers section 1
- 35 Side view without covers section 2



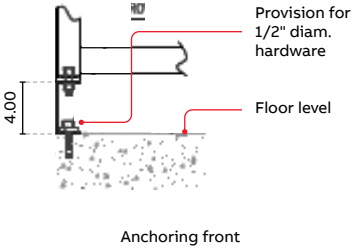
- 36  
Right side view
- 37  
Enclosure front top view
- 38  
Fastening floor detail:  
without scale
- 39  
Section A-A partial  
front view



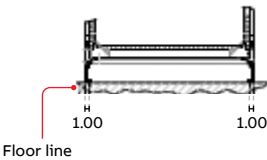
36



37



38

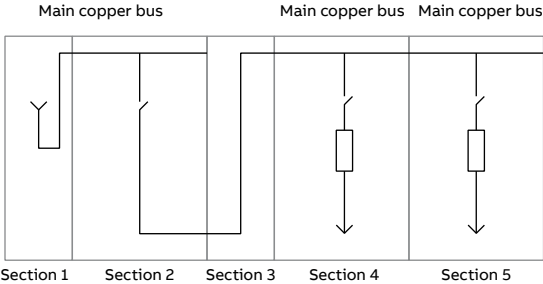


39

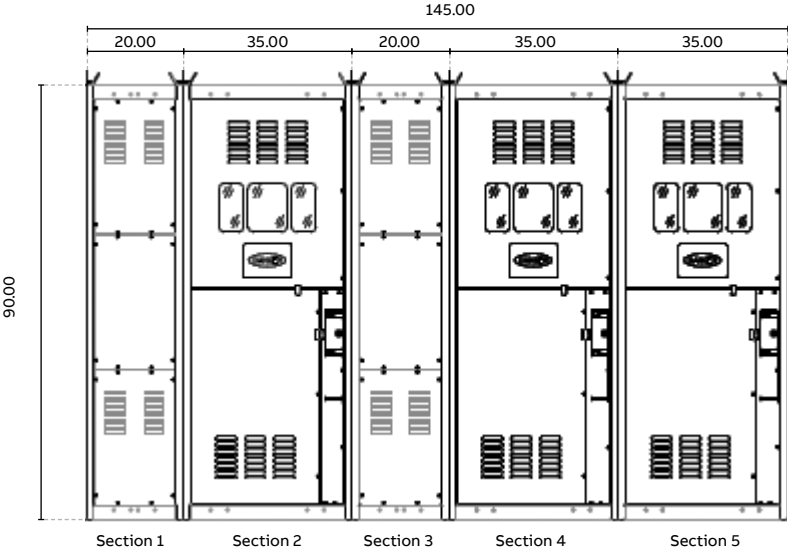
# Enclosure outline dimensions

## Typical line-up NEMA 1

—  
40  
Single line diagram  
—  
41  
Front view



—  
40



—  
41

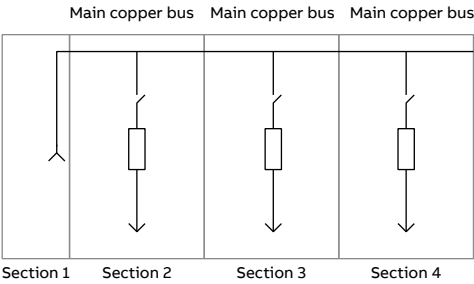
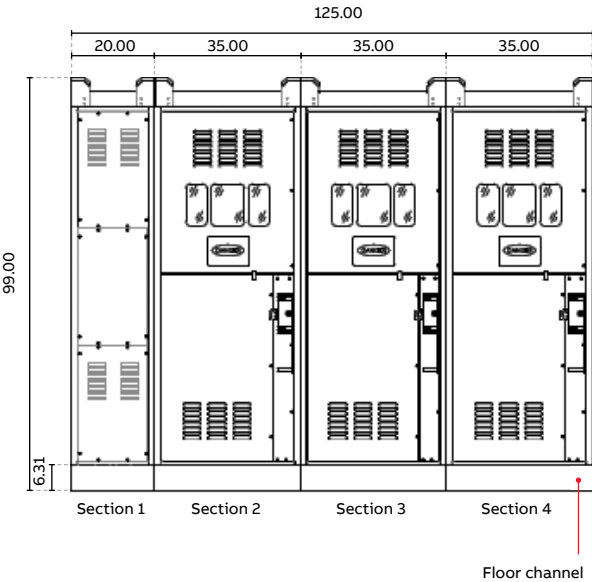




# Enclosure outline dimensions

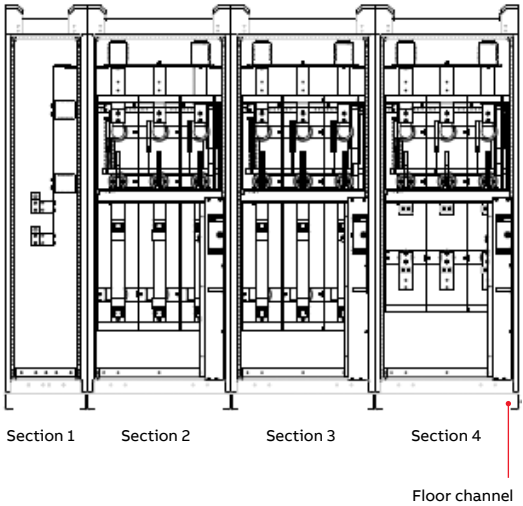
## Typical line-up NEMA 3R

- 46 Front view
- 47 Single line diagram
- 48 Front view without covers



47

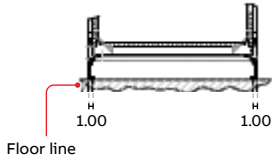
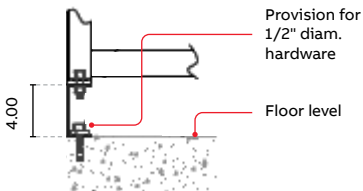
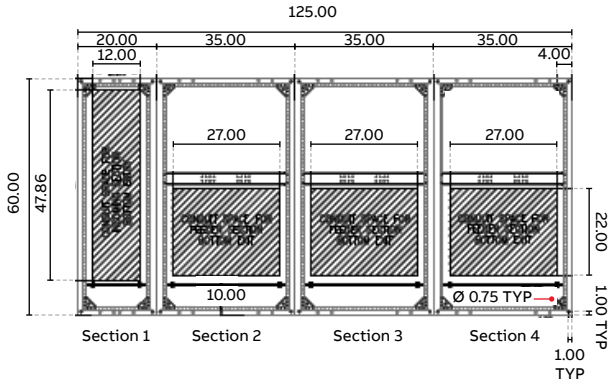
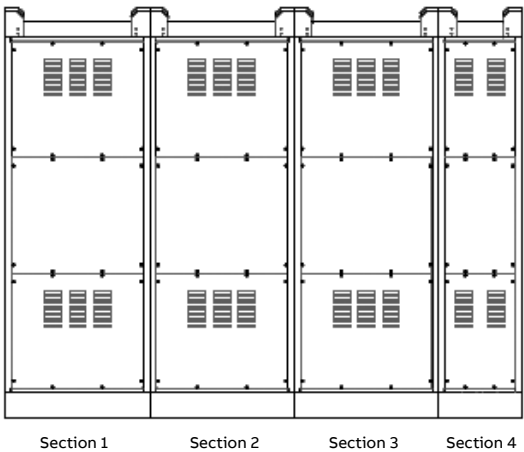
46



48

All dimensions are in inches.

- 49 Rear view
- 50 Enclosure front top view
- 51 Fastening floor detail: without scale
- 52 Section A-A partial front view

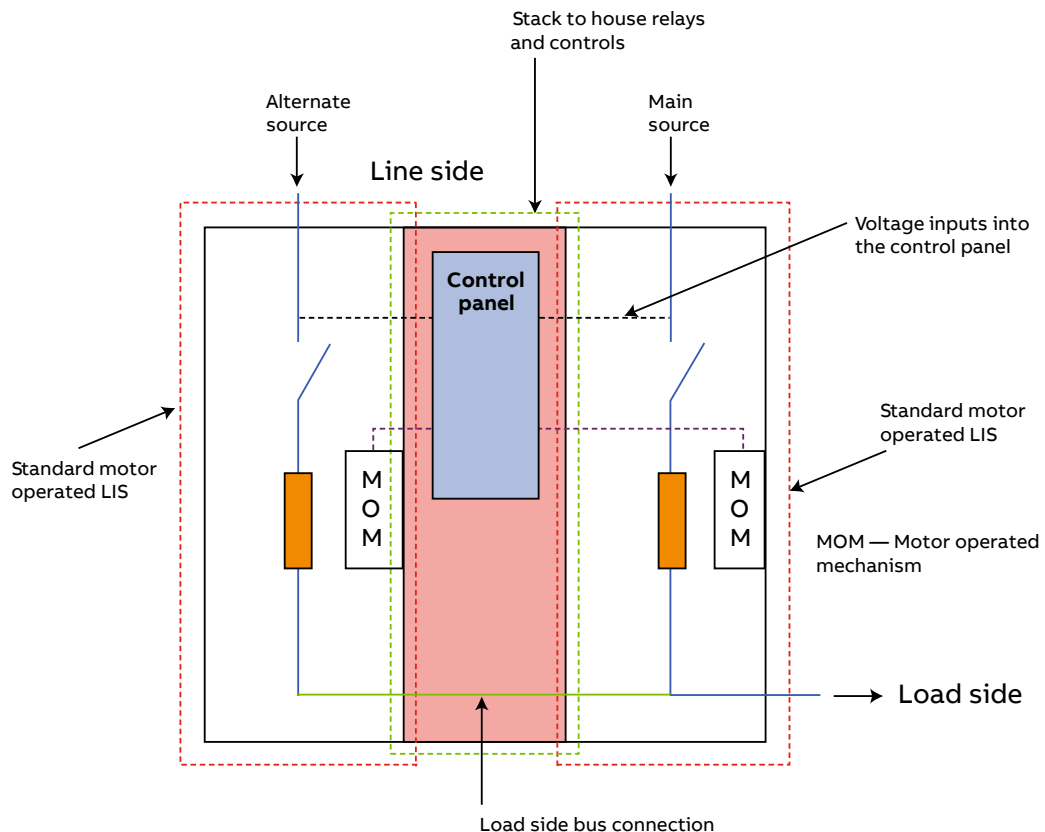


# BreakMaster™ load interrupter switch with automatic transfer switch

A load interrupter switch that uses advanced digital technology and motor operators to switch to emergency power when normal power fails.

53  
BreakMaster  
LIS ATS

- Voltage: 5 kV and 15 kV
- Rating current: 600 A and 1200 A
- Basic impulse level: 60 kV or 95 kV
- Power transfer timing: 7 seconds
- ABB ATS Controller OXCO\_ TruCONTROL
- HMI unit, available as Level 3 (LCD) and Level 4 (touch) for configuration and automatic operation
- Motor-operated switch mechanism
- Testing standards: UL 1008A
- Enclosures: NEMA 1, 3R
- Multiple switching options
- Solid-state controls
- Small footprint
- Economical design



VersaRupter® switch

VersaRupter is a general purpose, three-pole, loadbreak switch that offers switchgear owners and assemblers the benefit of an advanced interrupting technology and proven, dependable performance in a compact design.

—  
54  
VersaRupter  
switch

- Product highlights**
- Puffer arc extinguishing system allows for a high number of operations without excessive wear
  - Latches are not dependent on gravity, allowing for more flexibility in mounting arrangements
  - Tight phase spacing without the requirement for interphase barriers on a majority of ratings
  - Compact operating mechanisms available in stored energy or snap action varieties
  - Compact motor operator provides local or remote control of VersaRupter

The standard VersaRupter switch includes a heavy-duty steel frame with stand-off insulators, a unique puffer-type arc extinguishing system, an operating mechanism and current-carrying components, including blade-type interrupters with cast hinges and jaw connectors. Optional accessories and features include a variety of operating handles, a motor operator, auxiliary switches, a shunt trip device, mechanical door interlocking and key interlocking.



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Table 10: VersaRupter at a glance

Applications	Metal-enclosed switchgear for utility distribution, industrial, mining and commercial installations		
	Voltage	Loadbreak current	Momentary
	4.76–15 kV	600 A	40 kA momentary / 40 kA fault close
Ratings	4.76–15 kV	1200 A	61 kA momentary / 61 kA fault close
Standards	IEEE C37.20.4 (2001 and 2013) IEC 60129, 60254, 60265, 60694, 420, 62271-105 UL and CSA listings available for specific ratings		
Actuators	Manual operation with choice of chain drive, side direct drive or HE/HM shaft drive Optional motor operation, optional shunt trip with A-mechanism only		
Options	Auxiliary switches, key interlocks ISO-9001 Complete design type test certificates available upon request Switches are tested to a minimum of 1000 mechanical operations, 100 open/close operations up to 600 A, and 20 open/close operations at 1200 A		
Quality			

— 55  
K-mechanism

— 56  
A-mechanism

— 57  
Arc extinguishing  
puffer system

— 58  
Front chain drive handle

Table 11: VersaRupter® switch — technical details

Rated voltage (kV)	Rated maximum voltage (kV)	Rated current (A)	BIL (kV)	60 Hz withstand 1 minute (kV)	Pole spacing (in/mm)	Momentary current asymmetrical (kA)	Fault-making current asymmetrical (kA)	Short time current symmetrical (kA/sec)
13.8	15	600	95	36	9.25/235	40	40	25/2
13.8	15	1200	95	36	9.25/235	61	61	40/3

Snap action K-mechanism

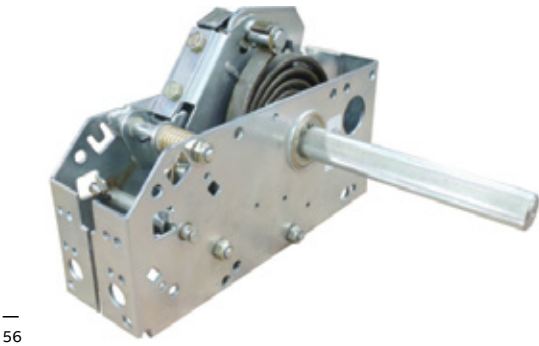
The K-mechanism is a single spring snap action device. The switch opens or closes by charging the spring past dead center using one of the manual operating handles. The K-mechanism may be used with all handle options as well as with type NM motor operators. The K-mechanism cannot be used for shunt trip, fuse or circuit breaker trip applications. Use K-mechanism if you need chain drive or front direct drive handles.



Stored energy A-mechanism

The A-mechanism is a dual spring stored energy device that is well suited for remote tripping applications. When shunt tripping, mechanical fuse or circuit breaker tripping is specified, the type A-mechanism must be used. In closed operation, the opening spring is charged and latched by an operating handle or by a motor operator. The VersaRupter is then opened by any of several methods:

- Movement of the operating handle
- Motor operator
- Electrical signal to a shunt trip device



Arc extinguishing puffer system

The puffer arc extinguishing system allows for a high number of operations without excessive wear with the following:

- Ablative arc chutes react to quench the arc
- A balanced combination of air and gas reliably extinguishes the arc
- Extended operations at full rated current
- 100 operation at full rated current vs. 10–20 when relying on ablatives only
- Less maintenance required due to reduced wear on arc chutes
- Eliminates the need for interphase barriers on most ratings



Front chain drive handle

- Kirk key provisions
- Padlock provisions
- Door interlock optional
- K-mechanism only





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59

HM front  
direct drive  
(motor) handle

—

60

Auxiliary  
switch

—

61

Shunt trip

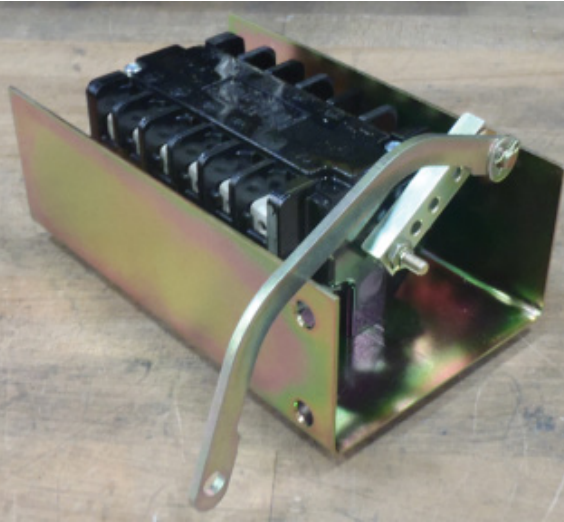
HM front direct drive (motor) handle

- Padlock provisions
- Kirk key and door interlock optional
- K-mechanism or A-mechanism



Auxiliary switch

- Changes state when the VersaRupter changes state via a mechanical linkage connected to the jack shaft
- Can be installed on all VersaRupter ratings
- Shipped with an equal number of NO and NC contacts, which can be reconfigured in the field
- Must be ordered and wired in series for shunt trip applications
- Available with 6 contacts (3 NO/3 NC)

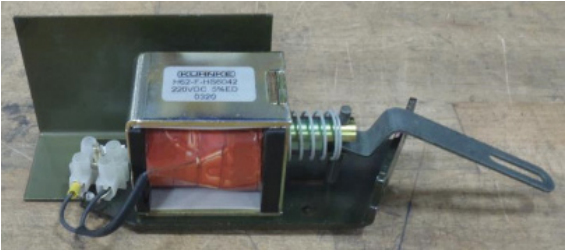


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60

Shunt trip

- Actuates the trip latch on the A-mechanism
- Can only be used with A-mechanism
- Activate by local pushbutton or remote
- Intermittent duty coil
- Auxiliary switch must be ordered and installed in series to remove power after VersaRupter change of state
- Can be used on all VersaRupter ratings with A-mechanism
- Only 110 V AC or 125 V DC available on BreakMaster LIS and BreakMaster V product



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61

Table 12: Technical data shunt trip device

Nominal coil voltage	Voltage range	Average current (amps)		Power (VA)	Resistance
		IN	Istart		
110 V AC	-15% to +10%	2.7	5.0	300	79 ± 15%
125 V DC	-15% to +10%	1.4	1.4	155	79 ± 15%

—  
62  
NM motor operator  
—  
63  
Spacer mounting bracket

**NM motor operator**

- Provides remote or local electrical opening of the VersaRupter
- Installed directly on the operating shaft of the VersaRupter
- Mounted on left side of switch and comes with shaft extension
- Can be used with either A-mechanism or K-mechanism
- Must use HM handle if manual operation is desired
- Motor mechanically disconnects after every operation to manually operate the VersaRupter if necessary
- Spacer mounting bracket must be ordered separately dependent upon switch rating and desired mounting location
- Only 110 V AC/DC available on BreakMaster LIS and BreakMaster V product



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62

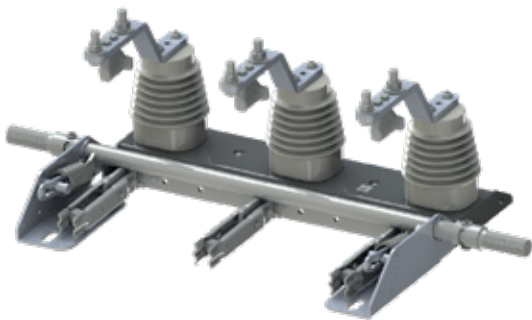


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63

—  
**Table 13: Technical data NH motor operator**

Voltage AC/DC ±10%	110 V
Current, A	0.8
Power consumption, W	85
Operating time, sec.	~4
Operating temperature, °F	-40 to 134
Signaling time, sec.	0.5–2.0
Weight, lb (kg)	13.2 (6)
Operating voltage, V AC	77–137
Operating voltage, V DC	99–150

**Grounding switches — Type EB**  
Quick earthing switch, designed to be an independent assembly and mounted on the load side of the VersaRupter switch



**Table 14: Technical data: ABB grounding switches — Type EB**

Rated voltage	kV	12.0–16.5, 22.9–24.9
Peak withstand current <sup>1</sup>	kA peak	38/82
Short circuit current	1 sec. kA	31.5
	2 sec. kA	20
	3 sec. kA	16
Short circuit making capacity	kA	38/50
Power frequency withstand voltage 50 Hz 1 min.	kV	50
Impulse withstand voltage 1.2/50 µs	kV	125
Pole distance	in/mm	9.25/235, 10.82/275

<sup>1</sup>When fed from switch disconnecter/grounding switch side

**Table 15: Earthing switch type EB used in 5/15 kV BreakMaster LIS**

Type	Rated voltage [kV]	Rated current [A]	Pole distance [mm]	Ordering number	Weight [kg]
EB 24	24	1250	235	1YMX054273M0001	24

# ATS Controller OXCO\_TruCONTROL

ATS Controller OXCO\_TruCONTROL is designed for use in emergency or standby systems to control the switches transferring a load automatically from one source to another.

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65  
ATS Controller OXCO\_  
TruCONTROL  
—  
66  
The control interfaces  
(HMI) for ATS Controller  
OXCO\_TruCONTROL

The ATS Controller OXCO\_TruCONTROL is operated by a control interface (HMI). The HMI is available in two levels: LCD (Level 3) or touch (Level 4) control interface. The ATS configuration is also done via the HMI.

The following automatic transfer switch application is possible with the BreakMaster LIS:

- Delayed transition: I - O - II

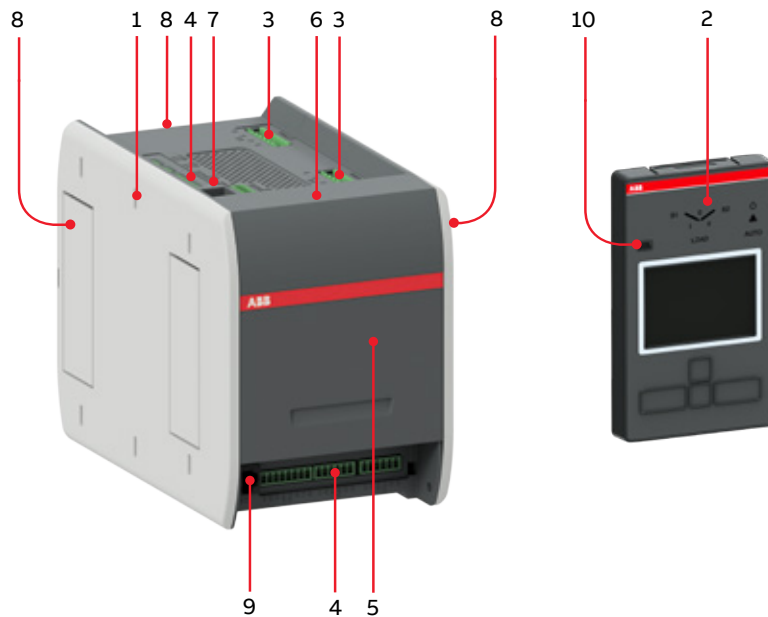


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65



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66

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67  
ATS Controller  
OXCO\_TruCONTROL  
and HMI unit  
—  
68  
HMI is available  
in two levels



—  
67

### General overview

- 1 ATS Controller OXCO\_TruCONTROL
- 2 HMI unit, two types of control interfaces, Level 3 (LCD) and Level 4 (touch), for configuration and automatic operation
- 3 Terminals for power supply connections
- 4 Terminals for control circuit connections
- 5 Product identification label and connectors label behind the cover
- 6 Place for connectivity modules (aux power supply, communication and signaling)
- 7 Place for rating plug
- 8 Places available for DIN rail adapters
- 9 Port for HMI (RJ45) connection cable
- 10 Programming port, only for Ekip programming module

### HMI for configuration and operation

HMI is the control interface (human machine interface), available in two different level types. Level 3 contains the HMI with LCD screen and Level 4 contains the HMI with touch screen. The HMI is used for configuration and automatic operation, to be ordered separately.

**Level 3:**  
HMI with  
LCD screen



I - O - II

**Level 4:**  
HMI with  
touch screen



I - O - II

—  
68

# VD4 circuit breakers

VD4 circuit breakers are the best choice for the majority of modern electrical distribution applications and are used in transformer and distribution substations to control and protect motors, transformers and capacitor banks and to protect cables.

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69  
VD4 circuit breaker

VD4 circuit breakers exemplify ABB’s proven vacuum interrupter engineering and manufacturing technology, as well as the superior design standards employed in the production of circuit breakers. VD4 medium voltage circuit breakers use vacuum interrupters embedded in the poles. This construction technique makes the poles of the circuit breaker particularly sturdy and protects the interrupter from shocks, dust and condensation. The vacuum interrupter houses the contacts and forms the interruption chamber.

**Vacuum current interruption**

The vacuum circuit breaker does not require an interrupting and insulating medium. Interrupters do not, in fact, contain ionizable material. The electric arc that generates when the contacts separate is merely formed by melted and vaporized contact material. Thus, the vacuum interrupter recovers insulating capacity and the ability to withstand transient recovery voltage, thereby definitively extinguishing the arc.

**Operating mechanism**

The low speed of the contacts, their reduced travel and exposed conductive part limit the energy required for operation and, therefore, ensure extremely low wear on the system. This means that the circuit breaker requires very little maintenance. VD4 circuit breakers have mechanical operating mechanisms with stored energy and free trip.

**The structure**

The operating mechanism and poles are fixed to a metal frame, which also acts as the support for the fixed version of the circuit breaker. The compact structure is sturdy and ensures mechanical reliability.



Table 16: Circuit breaker rating table

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69

	VD4	VD4
Rated voltage, kV	15	15
Frequency, Hz	60	60
Rated nominal current, A	2000	1200
Rated power frequency withstand voltage (1 min.), kV	38	38
Rated lightning impulse withstand voltage (peak values), kV	95	95
Rated short circuit breaking current, kA	31.5	40
Rated short time withstand current (3 sec.), kA	31.5	40
Rated peak making current, A	82	104
Actuator	Spring	Spring
Interrupting time, ms	≤50	≤50
Closing time, ms	30 to 60	30 to 80

# VM1 circuit breakers

VM1 are medium voltage circuit breakers with magnetic actuator for primary distribution for control and protection of cables, overhead lines, substations, motors, transformers, generators, etc., in plants such as: chemical industries, steelworks, automobile industries, airports, large buildings and shopping malls.

—  
70  
VM1 circuit breaker

**Magnetic actuation**

VM1 circuit breakers use vacuum interrupters embedded in the poles. The embedded interrupters are particularly sturdy and protect the interrupters against shocks, accumulation of dust and humidity. Each interrupter houses the contacts and makes up the interrupting chamber.

The magnetic drive activates the moving contacts of the interrupters and integrates all the functions of a traditional drive.

Actuation of the interrupter contacts is carried out by a single magnetic actuator controlled by position sensors and by an electronic module. The energy required for operation is provided by capacitors, which ensure an adequate store of energy. The electronic control circuit can be supplied in two versions: the “basic” one and the one with “full options,” which are characterized by:

- High electromagnetic immunity
- Self-diagnosis of the capacitor load and the continuity of the coils: controller watchdog with signaling of faults
- Wide range of auxiliary power supply in direct and alternating current

- Low consumption for maintaining capacitor load
- Determination of circuit breaker state by means of proximity sensors
- Monitoring of all the interruption functions

Thanks to the use of the embedded interrupters and the magnetic drive, the VM1 circuit breakers ensure:

- Sturdiness
- Reliability
- Long life
- Limited maintenance



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**Table 17: Circuit breaker rating table**

	VM1
Rated voltage, kV	15
Frequency, Hz	60
Rated nominal current, A	2000
Rated power frequency withstand voltage (1 min.), kV	38
Rated lightning impulse withstand voltage (peak values), kV	95
Rated short circuit breaking current, kA	31.5
Rated short time withstand current (3 sec.), kA	31.5
Rated peak making current, A	82
Actuator	Magnetic
Interrupting time, ms	≤50
Closing time, ms	30 to 60



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# Surge protection

Overvoltage damages reduce insulation life. There are many causes of accidental overvoltage whose effects may be reduced by protective means. The most prominent causes are:

- Lightning
- Physical contact with higher voltage system
- Repetitive restrike (intermittent grounds)
- Switching surges
- Resonance effects in series inductive capacitance circuits

Switching transients occur in every electrical system. Additional protection against surges may be economically attractive for system voltage installations of 2300 volts and above. This consists of a surge capacitor and lightning arresters. Lightning arresters reduce the amplitude of the voltage impulse wave. The surge capacitor further reduces the amplitude — but in addition, reduces the steepness of the wave front. Arresters may require a 20-inch wide auxiliary enclosure.



# Protection and control

## Relion® relays

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Relion 615

The Relion® family of protection and control relays for distribution applications provides the performance, safety and ease of use that switchgear specifiers and users demand. The Relion 615 and 640 series (REF/T/M/D 615 and REX 640) offer complete protection and control for feeders, motors and transformers and are characterized by their flexibility and performance in both today's and future distribution schemes.

Relion 615 and 640 series relays include:

- Comprehensive set of protection and metering functions for feeders, transformers and motors
- Draw-out design
- Integrated open/close pushbuttons and local/remote selector with indicating lights
- Enhanced safety with optional arc fault protection in all 615 and 640 series relays
- Web browser-based user interface accessible through an RJ45 front port

- Trip coil monitoring
- Monitoring of breaker health parameters such as travel time, number of operations, wear and tear and spring charging time
- DNP3 and Modbus protocols included standard in all relays
- Relion relays are fully IEC61850 compliant for communication and interoperability of substation automation devices
- Fully ANSI and RoHS compliant, as well as UL listed

If specified by the customer, BreakMaster load interrupter switchgear can also be delivered with other relay options.



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# Shark 100 power meter

## High accuracy power and energy measurement

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Shark 100  
power meter

### Overview

Shark 100 is one of the industry's highest performance revenue-grade panel meters. Based on an all new platform, this low-cost meter significantly outperforms other devices many times its price. This unit is perfect for new metering applications and as a simple replacement for existing analog meters.

### Applications

- Continuous metering of electrical loads such as generator panels, feeders, switchgear, etc.
- Provides remote status when used with the EnerVista software suite
- Low and medium voltage applications
- Replaces multiple analog meters, saving space and installation costs

### Key benefits

- High accuracy multifunction power meter
- Superior performance at competitive pricing
- Ultra-compact, easy to install, program and use
- 0.2% class revenue certifiable energy and demand metering
- Total harmonic distortion (%THD)
- Fits both ANSI and DIN cutout
- Large 3-line 0.56-inch bright LED display for better visibility and longer life
- User programmable for different system voltages and current measurements
- Standard Modbus and DNP communications
- Optional Ethernet port for simplified integration into new or existing LAN infrastructures and multi-point connectivity

### Features

#### Monitoring and metering

- True RMS multifunction measurements, including voltage, current, power, frequency, energy, etc.
- Meets ANSI C12.20 (0.2%) and IEC 687 (0.2%) accuracy classes
- Future field upgradeable for added functionality without removing installed meter
- Load percentage graphical bar for instant load visualization

#### Communications

- RS485 Modbus and DNP 3.0 protocol up to 57.6 K baud (serial option)
- Modbus TCP protocol through 10/100BaseTX via RJ45 (Ethernet option)
- 3-line 0.56-inch bright red LED display
- Front IrDA port laptop communication
- Pulse output for accuracy testing and energy



# Shark 200 power meter

## Power quality and energy cost measurement

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Shark 200  
power meter

### Overview

The Shark 200 meter provides revenue-class (0.2%) three-phase power metering with optional Ethernet, relay, status and analog output communication modules. This flexible meter can be used for a wide range of high accuracy applications, including disturbance recording and power quality studies.

Shark 200 can be mounted easily in a panel for generator monitoring, substation automation, power quality studies, data recording and more. The meter can also provide data to RTUs, PLCs and other control devices.

The Shark 200 is a highly accurate meter providing 0.1% accuracy for voltage and current. The unit's real-time clock provides time stamping of all logs as they are created. Up to 4 MB of data can be logged for analysis of historical trends, limit alarms, I/O changes power quality recording and sequence of events.

### Applications

- Four-quadrant energy and power monitoring of distribution feeders, transformers, reactors and generators
- Power monitoring of LV and MV industrial power control centers and motor control centers
- Energy monitoring of commercial and distribution utilities

### Key benefits

- Four-quadrant energy and power measurement, complying with ANSI C12.20 (0.2% accuracy)
- Analyze power quality over long periods of time to improve network reliability through high resolution event and disturbance recording
- Ideal for monitoring industrial power centers, data centers and hospitals due to high accuracy disturbance recording (up to 512 samples/cycle)
- Retrieve archived data, capture past events and analyze disturbances through high resolution data recording (up to 4 MB of data logging)
- Flexible communication options provide easy-to-access meter values, simplified configuration and seamless integration into new or existing automation systems



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**Features****Metering**

- Meets ANSI C 12.20 and IEC 687 (0.2%) accuracy
- Ia Ib Ic In
- Va Vb Vc Vab Vbc Vca
- Hz W VAR VA
- Wh VARh VAh
- Demand: W VAR VA
- Power factor
- Voltage and current angles
- Load bar

**Power quality**

- Harmonics to the 40th order
- Total harmonic distortion
- Disturbance recording and waveform capture
- Sag and swell

**Data logging**

- Up to 4 MB memory
- Disturbance recording
- Power quality studies
- Load studies

**Communications**

- Standard RS485 Modbus (DNP 3.0 and Modbus RTU or ASCII)
- Optional Ethernet 100BaseT
- IrDA Port
- Intuitive faceplate programming

**Software**

- Embedded web server
- Communicator
- EnerVista integrator
- EnerVista launchpad

# PQM II power quality meter

## Power quality and energy cost management

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PQM II power  
quality meter

### Overview

Multilin has set a new standard in metering technology with the introduction of the PQM II. This meter, designed on the latest industry specifications, provides accurate and reliable three-phase power metering with an optional Ethernet and fiber communications module in a small and modern package. The PQM II can be used for a variety of applications, including metering of distribution feeders, transformers, generators and motors.

### Applications

- Metering of distribution feeders, transformers, generators, capacitor banks and motors
- Medium and low voltage systems
- Commercial, industrial, utility
- Flexible control for demand load shedding, power factor, etc.

### Key benefits

- Power quality metering with waveform capture and historical data logging
- Easy to program and use with keypad and large illuminated 40-character display
- Multiple communication ports for integration with DCS and SCADA systems
- Supports DNP 3.0 and Modbus protocols
- Digital and analog I/Os for control and alarms
- Voltage disturbance recording capability for electrical sag and swell events

### Features

#### Monitoring and metering

- Ia Ib Ic In
- Va Vb Vc Vab Vbc Vca
- V I unbalance
- True PF crest and K factor
- Hz W VAR VA
- Wh VARh VAh W cost
- Demand: A W VAR VA
- Harmonic analysis through 63rd with THD and TIF
- Event recorder — 150 events
- Waveform capture
- Data logger — 98,000 events
- Voltage disturbance

#### Communications

- Front RS232 serial port (1200 to 19,200 bps)
- Two rear RS485 serial ports with ModBus and DNP 3.0 protocols
- Ethernet connectivity provided by MultiNet
- EnerVista software provided for setup and monitoring functions
- External dial-in modem capabilities

#### Protection and control

- A V W VAR VA varh Wh PF Hz unbalance
- A W VAR VA demand
- Load shedding
- Power factor control
- Pulse input totalizing



# Three-phase voltage monitors

## Model SPVRB

### General

UL listed file no. E103039, the model SPVRB voltage sensing relay is designed to protect against single phase, phase loss, phase unbalance, and phase reversal in a power system. The output contacts change their normal state only when a single phase, phase loss, phase unbalance or phase reversal occurs for longer than the preset trip delay. A total power loss or de-energization of the SPVRB relay will not change the output contact's position. Recommended for manual reset switches and breaker applications, the SPVRB is suitable for loss of phase with motor loads.

### Features

- Phase unbalance: 8%
- Adjustable trip delay: 1 to 10 seconds after failure occurs; prevents nuisance operations
- Output relay: Normally de-energized, form C contacts for easy circuit configuration
- Electro-mechanical indicator: Retains memory of fault until manually reset
- Door or panel mounting
- Status indicator: Bi-colored LED
  - Green: Output relay de-energized (normal condition)
  - Red: Output relay energized (fault condition)
  - Dark: Output relay de-energized (input power off)
- Single phase, phase loss protection, phase unbalance and phase reversal
- Automatic or manual mode
  - Automatic mode: Upon removal of fault conditions, relay automatically resets to normal
  - Manual mode: Upon removal of fault conditions, relay resets to normal after local or remote reset button has been pressed

SPVRB - XXX

Input voltage: 120/208/240/480 or 575 V AC, (60 Hz)  
380 or 415 V AC, (50 Hz)

- <sup>1</sup> Bi-colored LED indicator
  - Power system condition normal (green), trip (red)
- <sup>2</sup> Electromechanical diagnostic indicator
  - Phase loss
- <sup>3</sup> Adjustable system delay
  - Phase loss
  - Phase unbalance
  - Single phase
  - Phase reversal
  - Under and over voltage



# SwitchgearMD™

## Asset health monitoring

SwitchgearMD™ is a monitoring and diagnostic solution for temperature, humidity and partial discharge. It is available with new switchgear or for retrofit applications. Users can expect 24x7 continuous monitoring of equipment with the ability to monitor onsite via the ABB SWICOM HMI or ABB's RXplore app and remotely through a SCADA system or ABB's Asset Manager cloud application. This enables maintenance personnel to safely identify and fix problems before equipment failures, reducing outage times and increasing reliability.

Two different sensor solutions are available:

- Wireless solution for temperature, humidity and PD monitoring — surface acoustic wave (SAW) sensors and UHF measurements
- Wired solution for temperature and humidity monitoring — infrared (IR) sensors

Both sensor options allow for real-time monitoring. When employing IR sensors, a line of sight is required by the sensor. The infrared measurement is based on temperature rise over ambient ( $\Delta T$ ). This eliminates variances in panel-to-panel or site-to-site comparison. The reading is an mV output signal that is transmitted to an onsite HMI or to a control system.

IR sensors consist of a non-conductive plastic body, hermetically sealed and fully potted, that does not change mechanically or metallurgically during its service life. There are no active electronic components and no power source other than the thermoelectric effects that produce the temperature signal. Sensors have a lifetime calibration and are UL recognized and CE certified.

The other sensor type for temperature monitoring is a surface acoustic wave (SAW) sensor. SAW temperature sensors are wireless, surface-mount, passive components. There are no active electronic components and no power source is required.

The embedded piezoelectric SAW transducer element converts a small electrical current to vibrations and then back to an electrical signature correlated to temperature. The sensor has an internal antenna that reflects a wireless RF signal to the external antenna. The external antenna is passive and receives RF signals from the reader. The reader is active and powered by 24 V DC supply to generate the RF signal that the antenna transmits.

The radio frequency transceiver provides remote interrogation of multiple wireless passive SAW sensors (up to 12 sensors in 1 cubicle with 2 pairs of antennas, or 6 sensors in 3 adjacent cubicles, with 1 pair of antennas in each cubicle). This device is compact and mounted within the low voltage compartment.

The ABB standard solution is to monitor the temperature at all outgoing/incoming cable connection points.

When partial discharge (PD) monitoring is required along with temperature and/or humidity monitoring, the wireless solution must be used. If only PD monitoring is required, then only the antennas are provided. The antennas perform the PD monitoring.

## Cable temperature ratings

When insulated primary cables are used for outgoing or incoming feeder connections to the switchgear bus, the recommended cable temperature rating is 90 °C. The full load current rating for the cable should be based on 90 °C ratings. This is because temperature limits at connection joints for incoming or outgoing cables are limited to a 45 °C rise over a 40 °C ambient, for a total temperature limit of 85 °C. If the bus to which the cable is connected is rated for 1200 A, then the cable size and temperature ratings should not exceed 1200 A at the 90 °C temperature rating of the cable.

Using a lower temperature rating, such as a 75 °C rated cable, could result in the cable becoming overheated if the bus connection is operated at full rated current.

Using a higher temperature rating, such as a 105 °C rated cable could result in the bus bar connection being overheated if the bus connection is operated at full rated current. When using cables with higher temperature ratings than 90 °C, the cables should be sized at the 90 °C ratings for full load current ratings.

# Fuses

BreakMaster LIS is available with a variety of current limiting and expulsion fuses to meet specific application needs.

Fuses are readily accessible, easily removed and retained in position by high pressure fuse clips to prevent slippage or displacement during operation.

A phase loss detection relay and PTs are installed on the load side of fuses and wired to terminal blocks to provide blown fuse indication. For blown fuse trip option, a shunt trip is installed in addition to the components above and wired to terminal blocks for external power source, provided by others. Capacitive trip device can be provided but it is a manual selection and factory must quote.

**Table 18: Fuses**

Fuse number prefix	Max. voltage kV	Number of barrels	Manufacturer	Current ratings
9F62HCB	5.5	1	Mersen	25 A–65 A
9F62DCB	5.5	1	Mersen	80 A–200 A
9F52FCB	5.5	2	Mersen	250 A–450 A
9F62HDD	15.5	1	Mersen	25 A–30 A
9F52DDD	15.5	1	Mersen	50 A–100 A
9F52FDD	15.5	2	Mersen	125 A–200 A
9F62KED	15.5	4	Mersen	300 A
9F52KCB	5.5	4	Mersen	500 A–600 A
A055BI	5	1	Mersen	10 A–200 A
A055B2	5	2	Mersen	250 A–450 A
A055F1CORO	5.5	1	Mersen	25 A–65 A
A055F1DORO	5.5	1	Mersen	80 A–200 A
A155B3	15	3	Mersen	300 A
8RBA2	8.3	1	Eaton	10 A–200 A
15RBA2	15.5	1	Eaton	10 A–200 A
8RBA4	8.3	1	Eaton	0.5 A–400 A
15RBA4	15.5	1	Eaton	0.5 A–400 A
8RBA4	8.3	1	Eaton	0.5 A–400 A
15RBA4	15.5	1	Eaton	0.5 A–400 A
8RBA8	8.3	2	Eaton	450 A–720 A
15RBA8	15.5	2	Eaton	450 A–720 A
SM4Z	5	1	S&C	3 A–200 A
SM4Z	15	1	S&C	3 A–200 A
SM5S	5	1	S&C	3 A–400 A
SM5S	15	1	S&C	3 A–400 A

# Control power transformers (CPTs)

CPTs are designed to provide control power in BreakMaster LIS and BreakMaster V switchgear. All CPTs are manufactured to meet the requirements of IEEE C57.12.01. Primary windings are vacuum-cast for high dielectric strength and ruggedness. Transformers are constructed with high quality, grain-oriented core steel and copper conductors. CPTs can be mounted in the rear lower compartment of the unit.

**Table 19: Control power transformers**

Part no.	Description
CPTA6052400D148	CPT (2400/120/240) multi-tap
CPTA6054160D148	CPT (4160/120/240) multi-tap
CPTA6054800D148	CPT (4800/120/240) multi-tap
CPTA9557200D116	CPT (7200/120/210) in line tap
CPTA9558400D146	CPT (8400/120/240) in-line tap
CPTA95512000D146	CPT (12000/120/240) in-line tap
CPTA9557200D148	CPT (7200/120/240) multi-tap
CPTA9558400D148	CPT (8400/120/240) multi-tap
CPTA95512000D148	CPT (12000/120/240) multi-tap
CPTA95512470D148	CPT (12470/120/240) multi-tap
CPTA95513200D148	CPT (13200/120/240) multi-tap
CPTA95513800D148	CPT (13800/120/240) multi-tap
CPTA95514400D148	CPT (14400/120/240) multi-tap
CPTA9558400D150	CPT (8400/120/240) multi-tap
CPTA95512470D150	CPT (124 70/120/240) multi-tap
CPTA95513200D150	CPT (13200/120/240) multi-tap

# Voltage transformers and current transformers

Potential transformers or voltage transformers (PTs) are indoor type, designed for metering and relaying applications. The primary and secondary coils of the transformer are wound using special winding and shielding techniques for improved voltage stress distribution.

BreakMaster LIS and BreakMaster V utilize ABB VIY-60 and VIZ-11 transformers. The entire assembly is cast in polyurethane under vacuum for added insulation and protection. PTs are supplied with primary fusing to take the transformer off-line in the event of an internal failure and to protect the transformer from partial primary and secondary short-circuit. PTs can be mounted in the rear or front of the BreakMaster frame or in an auxiliary

(20" or 35") section. When mounted in the rear, the depth of the frame becomes at least 60 inches.

BreakMaster LIS and BreakMaster V are available with SCV type CTs for relaying and metering. A set of three CTs (one per phase) can be mounted. The ring-type core is insulated and toroidally wound with a fully distributed secondary winding. The protective case, made of an impact-resistant polycarbonate, is assembled using self-tapping screws. Secondary terminals are 10–32 brass terminal screws with hardware. Saturation, overcurrent ratio correction factor and phase-angle curves are available upon request. These units meet all applicable IEEE standards and are UL-recognized components.

**Table 20: Voltage transformers**

Part no.	Description
7525A51G01	PT 2400/4150Y, 120 V
7525A51G02	PT 4200/4200Y, 120 V
7525A51G03	PT 4800/4500Y, 120 V
7525A67G05	PT 7200/12470Y, 120 V
7525A67G06	PT 7620/113200Y, 120 V
7525A67G07	PT 8400/14560Y, 120 V
7525A67G08	PT 12000/12000Y, 120 V
7525A67G09	PT 13200/13200Y, 120 V
7525A67G10	PT 14400/14400Y, 120 V
7525A67G106	PT 12000/12000Y, 120 V, 100:1

**Table 21: Current transformers**

Part no.	Description
7527A70G01	CT, 100 A, C10
7527A70G02	CT, 150 A, C10
7527A70G03	CT, 200 A, C20
7525A67G04	CT, 250 A, C20
7525A67G05	CT, 300 A, C20
7525A67G06	CT, 400 A, C20
7527A70G07	CT, 500 A, C50
7527A70G08	CT, 600 A, C50
7527A70G09	CT, 800 A, C100
7527A70G10	CT, 1000 A, C100
7527A70G11	CT, 1200 A, C200
7527A70G12	ITI-GE ground fault sensor CT 50:5

# Packaging and storage

## Domestic packaging

Normally a BreakMaster or BreakMaster V line-up is shipped in individual vertical sections for ease of handling. A customer can request shipping splits of 3 sections maximum. Each section or shipping split is mounted on a hardwood skid to facilitate moving by rollers or fork-lift truck. Lifting eyes are also provided for moving by crane. Shipping blocks are placed on the face of the sections to protect handles and devices. The sections are wrapped in clear stretch polyfilm to protect the equipment from the usual dust and dirt encountered during shipment. Necessary bus splice bars are included for connecting the sections together.

## Export crating

The sections are bolted to a skid with a solid floor. The equipment is then enclosed in a 3/8" plywood crate with 2 x 4 reinforcing at the top and corners. Three 1- 1/4" steel bands are placed horizontally around the crate for additional reinforcing.

All equipment should be protected against moisture and temperature extremes during shipment and storage (see Environmental Considerations in Overview section). For prolonged shipping periods where export crating is involved, it is recommended the equipment space heaters (when specified) be wired for connecting to an external power source while in transit, to minimize condensation.

## Storage

If it is necessary to store the equipment for any length of time, the following precautions should be taken:

1. Uncrate equipment.
2. Store in a clean, dry area at moderate temperature. Cover with a suitable canvas or heavy-duty plastic cover to prevent entrance of foreign material.
3. If equipment must be stored in cool or damp areas, not only should the equipment be completely covered, but heat should be provided to prevent condensation of moisture in the equipment. Energize space heaters (if furnished in the equipment) or place a standard 120-volt lamp rated 75 watts inside the bottom of each vertical section.

## Paint finish

### Indoor equipment

The standard paint system consists of the following two processes:

### Phase I — Cleaning

In a 7-stage spray washer, steel parts are cleaned and sprayed in controlled cleaning solutions.

Table 22

Stage	Temperature	Chemical solution(s)
1–Cleaning	115–120 °F	Ferro clean
2–Rinse	105–118 °F	None
3–Iron phosphate	90–105 °F	Secure low foam
4–Rinse	Ambient	None
5–Non-chrome sealer	Ambient	Non-chrome final seal
6–Rinse	Ambient	None
7–Deionized rinse	Ambient	None

Cleaned steel parts enter a drying oven at 300–350 °F. The preceding operating parameters have been determined to produce an iron phosphate coating of a minimum of 150 milligrams per square foot to meet MIL spec TT-C-490.

### Phase II — Painting by electrostatic powder process

Primed metal parts are electrostatically coated with a powder paint consisting of 670-011 ANSI-61 polyester paint (light gray). Metal parts will enter drying oven at 360 °F and remain for 10 minutes. The standard color is ANSI-61 light gray with a gloss of 6–12, and a thickness of 2–4 mils. This system will withstand a minimum of 1000 hour humidity test and 1000 hours salt spray tests per ASTM 117B.











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**ABB Inc.**

305 Gregson Drive  
Cary, NC 27511 USA  
[abb.com/contacts](http://abb.com/contacts)

**[abb.com/mediumvoltage](http://abb.com/mediumvoltage)**

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